IN THE CLAIMS:

1. **(Currently Amended)** A method for reconstructing image information from a Compton camera, comprising:

(a) obtaining observed data from the Compton camera, the observed data resulting from a source distribution;

(b) mapping the observed data by backprojection to form a backprojected function;

(c) determining an intermediate function from the backprojected function, wherein the intermediate function is dependent on an associated transform of the backprojected function;

(d) filtering the intermediate function to form a filtered function, wherein the filtered function corresponds to a corresponding transform of a source distribution function; and

(e) inverse transforming the filtered function to obtain the source distribution function and to form directly a three-dimensional image representative of the source distribution.

2. **(Original)** The method of claim 1, wherein the source distribution function represents a distribution of a radiopharmaceutical substance within a patient's body.

3. **(Original)** The method of claim 1, wherein the associated transform of the backprojected function comprises an associated Fourier transform of the backprojected function and wherein the corresponding transform of the source distribution function comprises a corresponding Fourier transform of the source distribution function.

4. **(Original)** The method of claim 1, wherein (d) comprises:

(i) determining a filtering function Φ from a camera geometry of the Compton camera; and

(ii) determining the filtered function F by multiplying the intermediate function H by the filtering function Φ.

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5. (Original) The method of claim 4, wherein the Compton camera comprises a primary detector and wherein (i) comprises:

> (1) determining the filtering function from a detector geometry of the primary detector.

6. (Original) The method of claim 1, wherein (b) comprises:

> (i) determining a first index (p), wherein the observed data is modeled in accordance with the first index and wherein the observed data is associated with a number of events;

> (ii) in response to (i), selecting a second index (q);

> (iii) if the number of events is greater or equal to a predetermined number, creating a histogram for the events and backprojecting the histogram in accordance with the second index; and

> (iv) if the number of events is less than the predetermined number, applying a backprojection operator for each event in accordance with the second index and summing corresponding individual results.

7. (Original) The method of claim 6, wherein the first index equals a non-integer value.

8. (Original) The method of claim 7, wherein a value of the first index is selected from the group consisting +1/2, -1/2, and +3/2.

9. (Original) The method of claim 8, wherein a corresponding value of the second index equals +3/2, +5/2 and +1/2, or +1/2 if the value of the first index equals +1/2, -1/2, or +3/2, respectively.

10. (Original) The method of claim 6, wherein the predetermined value approximately equals 10^{10}.

11. (Original) The method of claim 6, wherein (c) comprises:

> (i) determining the intermediate function from a combination of Fourier transforms of the backprojected function, each associated Fourier transform corresponding to a selected second index.

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12. **(Original)** The method of claim 11, wherein (i) comprises:

(1) if the first index equals +3/2, calculating the intermediate function by:

$$H(\vec{v}) = B_q(\vec{v})\text{, where the second index (q) equals +1/2;}$$

(2) if the first index equals +1/2, calculating the intermediate function by:

$$H(\vec{v}) = B_q(\vec{v})\text{, where the second index (q) equals +3/2; and}$$

(3) if the first index equals -1/2, calculating the intermediate function by:

$$H(\vec{v}) = B_{q1}(\vec{v}) + \frac{1}{(2\pi R_C|\vec{v}|)^2} B_{q2}(\vec{v})\text{, where q1 is a first value of the second index}$$

and equals +5/2 and q2 is a second value of the second index and equals +1/2, and where R_C corresponds to a radius of a primary detector of the Compton camera.

13. **(Currently Amended)** The method of claim 4, wherein (i) comprises:

(1) if a primary detector is characterized by a rectangular shape or a square prism shape or a cylindrical shape, determining the filtering function by:

$$\Phi(\vec{v}) = \frac{4\pi(R_C)^2}{K}|\vec{v}||\vec{v} \bullet \vec{e}_z|\text{, where } R_C \text{ is a corresponding parameter of the primary}$$

detector and K is a constant that is dependent on a shape of the primary detector;

(2) if the primary detector is characterized by a circular shape, determining the filtering function by:

$$\Phi(\vec{v}) = \frac{\pi(R_C)^3}{L}|\vec{v}|\sqrt{(\vec{v} \bullet \vec{e}_Y)^2 + (\vec{v} \bullet \vec{e}_z)^2}\text{, where L corresponds to a radius of the}$$

primary detector and R_C is a measure of an imaging region; and

(3) if the primary detector is characterized by a spherical geometry, determining the filtering function by:

$$\Phi(\vec{v}) = 2(R_C)^2|\vec{v}|^2\text{, where } R_C \text{ is a radius of a corresponding sphere}$$

14. **(Original)** The method of claim 1, further comprising:

(f) repositioning the Compton camera; and

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(g) repeating (a)-(e).

15. (Original) The method of claim 14, wherein (f) comprises:

(i) scanning the Compton camera along an axis of a patient's body.

16. (Original) The method of claim 7, wherein the first index (p) is a half-integer value.

17. (Original) A computer-readable medium having computer-executable instructions for performing the method as recited in claim 1.

18. (Original) A computer-readable medium having computer-executable instructions for performing the method as recited in claim 4.

19. (Original) A computer-readable medium having computer-executable instructions for performing the method as recited in claim 5.

20. (Original) A computer-readable medium having computer-executable instructions for performing the method as recited in claim 6.

21. (Currently Amended) An apparatus for reconstructing a reconstructed three-dimensional image of a radiopharmaceutical source distribution, comprising:

a Compton camera; and

a processor that is coupled to the Compton camera to receive camera data, the processor configured to perform:

(a) obtaining observed data from the Compton camera, the observed data resulting from a source distribution;

(b) mapping the observed data by backprojection to form a backprojected function;

(c) determining an intermediate function from the backprojected function, wherein the intermediate function is dependent on an associated transform of the backprojected function;

(d) filtering the intermediate function to form a filtered function, wherein the filtered function corresponds to a corresponding transform of a source distribution function; and

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(e) inverse transforming the filtered function to obtain the source distribution function and to form directly the reconstructed three-dimensional image.

22. **(Original)** The apparatus of claim 21 wherein the processor, when performing (d), is configured to perform:

(i) determining a filtering function Φ from a camera geometry of the Compton camera; and

(ii) determining the filtered function F by multiplying the intermediate function H by the filtering function Φ.

23. **(Original)** The apparatus of claim 21 wherein the processor, when performing (b), is configured to perform:

(i) determining a first index (p), wherein the observed data is modeled in accordance with the first index and wherein the observed data is associated with a number of events;

(ii) in response to (i), selecting a second index (q);

(iii) if the number of events is greater or equal to a predetermined number, creating a histogram for the events and backprojecting the histogram in accordance with the second index; and

(iv) if the number of events is less than the predetermined number, applying a backprojection operator for each event in accordance with the second index and summing corresponding individual results.

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24. (Currently Amended) The apparatus of claim 21, further comprising:

an output module that displays the reconstructed three-dimensional image of the radiopharmaceutical source distribution.

25. (Currently Amended) The apparatus of claim 21, further comprising:

a repositioning module that instructs the Compton camera to reposition along a patient's body to reconstruct a the three-dimensional image of the radiopharmaceutical source distribution.

26. (Original) The apparatus of claim 21, wherein the Compton camera comprises a primary detector (D1) and a secondary detector (D2), wherein the observed data corresponds to a set of events and wherein each event ($\vec{z}, \vec{n}, \sigma, E$) is provided by the primary detector and the secondary detector, where $\vec{z}$ corresponds to a position of Compton scattering on the primary detector, $\vec{n}$ corresponds to a direction of γ-ray propagation after scattering, σ corresponds to an angle of γ-ray propagation before scattering, and E corresponds to an energy of an emitted γ-ray.

27. (Original) The apparatus of claim 26, wherein a linear dimension of the primary detector is at least four times greater than a corresponding linear dimension of an object being imaged.

28. (Original) The apparatus of claim 26, wherein the processor is configured to perform:

(f) sampling the vector $\vec{n}$ on a hemisphere.

29. (Currently Amended) The A method of reconstructing image information from a Compton camera, comprising:

(a) obtaining observed data from the Compton camera, the observed data resulting from a source distribution, wherein the source distribution corresponds to a radiopharmaceutical substance within a patient's body;

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(b) mapping the observed data by backprojection to form a backprojected function, wherein the observed data is backprojected on a cone, and wherein (b) comprises:

(i) determining a first index (p), wherein the observed data is modeled in accordance with the first index, wherein the observed data is associated with a number of events, and wherein a value of the first index is selected from the group consisting of +1/2, -1/2, and +3/2;

(ii) in response to (i), selecting a second index (q), wherein a corresponding value of the second index equals +3/2, 5/2 and 1/2, or 1/2 if the value of the first index equals 1/2, -1/2, or 3/2, respectively;

(iii) if the number of events is greater or equal to a predetermined number, creating a histogram for events and backprojecting the histogram in accordance with the second index; and

(iv) if the number of events is less than the predetermined number, applying a backprojection operator for each event in accordance with the second index and summing corresponding individual results;

(c) determining an intermediate function from the backprojected function, wherein the intermediate function is dependent on an associated Fourier transform of the backprojected function;

(d) filtering the intermediate function to form a filtered function, wherein the filtered function corresponds to a corresponding Fourier transform of a source distribution function, wherein (d) comprises:

(i) determining a filtering function Φ from a camera geometry of the Compton camera; and

(ii) determining the filtered function F by multiplying the intermediate function H by the filtering function Φ; and

(e) inverse transforming the filtered function to obtain the source distribution function and to obtain directly a three-dimensional image that is representative of the source distribution, wherein the source distribution function corresponds to an image of the source distribution.

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